UNIVERSITI TEKNIKAL MALAYSIA MELAKA

Design and Analysis of Welding Fixture Based on Dynamic Load Condition

This report submitted in accordance with requirement of UniversitiTeknikal Malaysia Melaka (UTeM) for Bachelor Degree of Manufacturing Engineering (Manufacturing Design) (Hons.)

by

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UNIVERSITI TEKNIKAL MALAYSIA MELAKA

DESIGN AND ANALYSIS OF FEEDER UNIT FOR OIL PALM FIBER INTAKE SECTION

This report submitted in accordance with requirement of Universiti Teknikal Malaysia Melaka (UTeM) for Bachelor Degree of Manufacturing Engineering (Manufacturing Design) (Hons.)

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ABSTRAK

Lekapan kimpalan ditakrifkan sebagai alat yang digunakan untuk memudahkan kerja-kerja kimpalan dan menjimatkan masa dalam menghasilkan produk. Penggunaan lekapan kimpalan juga merupakan salah satu langkah keselamatan mengelakkan pengimpal daripada kecederaan semasa mengendali proses kimpalan. Projek ini dijalankan untuk mengkaji parameter reka bentuk lekapan kimpalan yang baru yang digunakan untuk menyambungkan bahagian pintu pagar seperti pintu pagar yang digunakan di rumah. Di samping itu, tiga idea konsep telah dibincangkan. Tambahan pula, konsep yang terbaik telah digunakan dalam analisis ini berdasarkan 3 bahan calon yang berbeza. Bahan yang paling sesuai untuk lekapan kimpalan telah diperolehi melalui simulasi. Model lekapan kimpalan 3D dilukis dengan menggunakan perisian Solidwork 2013. Analisis terma sementara dan analisis struktur statik pada lekapan kimpalan dijalankan dengan menggunakan perisian ANSYS 14.0. Hasil daripada analisis struktur statik telah diinterpretasikan dalam lima aspek: tegasan setara, pengubahan bentuk, faktor keselamatan (F.O.S), hayat lesu dan kerosakan keletihan. Walau bagaimanapun, hasil daripada analisis terma sementara telah diinterpretasikan dalam dua aspek: suhu dan jumlah agihan fluks haba. Oleh itu, ia telah dicadangkan bahawa keluli tahan karat adalah yang sesuai untuk lekapan kimpalan.

ABSTRACT

Welding fixtures defined as a tool used to facilitate the work of welding and saving time to produce a product. The use of welding fixture is also one of a safety measure prevent the welder from injury while handling welding process. This project was undertaken to study the design parameters of the new welding fixtures used for joining the gate parts such as the gate used at home. In addition, three concept ideas were discussed. Furthermore, the best concept has been used in this analysis based on 3 candidate materials. The most suitable material for welding fixtures was obtained through simulation. 3D model welding fixture was created by using Solidwork 2013 software. Transient thermal analysis and static structural analysis were performed on welding fixture by using ANSYS 14.0 software. Result of static structural analysis was interpreted in five aspects: Equivalent stress, total deformation, factors of safety (F.O.S), fatigue life and fatigue damage. However, the result of a transient thermal analysis was interpreted in two aspects: temperature and total heat flux distribution. Therefore, it was proposed that stainless steel is the suitable for welding fixtures.

DEDICATION

To my beloved parent, siblings, friend, my respectful supervisor and examiner for their love and support

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LIST OF ABBREVIATIONS, SYMBOLS AND NOMENCLATURE

ASTM	-	American Society for Testing and Materials
EBW	-	Electron-Beam Welding
FEA	-	Finite Element Analysis
FCAW	-	Flux Cored Arc Weldments
FOS	-	Factor of Safety
GMAW	-	Gas Metal Arc Welding
GTAW	-	Gas Tungsten Arc Welding
HSS	-	High Speed Steel
IGES	-	Initial Graphics Exchange Specification
MMAW	-	Manual Metal Arc Welding
MMA	-	Manual Metal Arc
OHNS	-	Oil Hardening non Shrinking
PAW	-	Plasma Arc Welding
PSM 1	-	Projek Sarjana Muda 1
PSM 2	-	Projek Sarjana Muda 2
SAW	-	Submerged Arc Welding
SMAW	-	Shielded Metal Arc Welding

CHAPTER 1

INTRODUCTION

This chapter describes the key of general terms that implemented for this project. It covers the background of the problem, objectives, scope, and significant and research methodology.

1.1 Background

Nowadays, fixture is an important thing in manufacturing field. In Malaysia, a lot of factory used the fixture to increase the productivity for their product. In manufacturing process, fixture is defined as a tool or the base for holding the workpieces (Zhang et al., 2009). The fixture is designed and created depend on the process involve on the workpieces. Usually, the fixture is used for inspecting the workpiece, assemble the part, machining process, and welding process.

A general tool such as clamps and locator used in welding fixtures is to coordinate and maintain various pieces for welding. Almost all welding equipment is designed and built to meet a specific need of a single assembly. Normally, the cost to build and designing the welding equipment is very expensive. Therefore, it takes a long time to produce a new design and installation of welding equipment at the plant (Zhang et al., 2009).

Welding fixtures can be produced in two different forms of process either manually or automatically. Usually, welding fixture is widely used in the automotive field for an automotive body welding assembly line. In manufacturing system cost, the cost of producing fixtures is about to 10-20% (Zhang et al., 2009). Therefore, a fixture system is designed and built for producing as many workpieces as possible to reduce manufacturing cost. In large production, the fixture size is large and must suitable follow the workpieces size. In low-to-medium production, the flexible fixture system is the one of improvement in order to reduce the unit cost of product (Hoffman, 2004).

1.2 Problem Statement

Gate is important for safety and protection. In order to join the gate part, welding is the best process used for joining the metal part. The quantity of gate part to assemble is a one of the problem to get less time produce and accuracy of welder. One of solving for this problem is built the welding fixture for joining the gate structure. The welding fixture was designed to hold the gate part during assembly processed. However, there is a lack of study in designing of fixture. In this research, the new design of welding fixture and the best material selection based on research were discussed. In addition, some analysis will be conducted to ensure the fixture material can withstand standard welding temperature and long term use based on dynamic load condition.

1.3 Objective

The objectives of this project are:

1. To investigate the design parameter for welding fixture by using Solidwork 2013 software.
2. To analyze the welding fixture by using ANSYS 14.0 software.
3. To determine the factor of safety for welding fixture.

1.4 Scope of project

Fixtures scope is not limited because it has many elements such as locators, clamps, essential features of fixture and others. However, this research only covers about the holding workpieces on welding fixture. The workpieces material is ASTM A500 grade A also known as 1027 plain carbon steel. The type of welding process involve in this research is Shielded metal arc welding (SMAW). In this welding process, the base metals are heated to fusion or melting temperature by an electric arc. The shielding gas is created as the flux covering on the electrode melts. When the flux solidifies, it forms a protective slag over the weld bead. The melting electrode wire furnishes filler metal to the weld welding process with initial temperature, $T_1 = 1,540\ °C$ for ASTM A500 grade A material. Besides that, the temperature , $T_2 = 924\ °C$ is the assumed heat flow to the surface fixture during welding process. In this research, the temperature , $T_2 = 924\ °C$ is base on the reduction of the heat as much as 40% from the welding temperature, $T_1 = 1,540\ °C$. Besides, there are no specific experiments performed to study the actual temperature of the heat flow to the fixtures surface in this analysis. Furthermore, the ambient temperature , $T_\infty = 30°C$ is assumed as surrounding temperature in welding room.